Backpropagation Processing of GPS Radio Occultation Data

C. O. Ao, G. A. Hajj, S. S. Leroy, T. K. Meehan, M. de la Torre Juarez, B. A. Iijima, and A. J. Mannucci

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA

It is known that sharply varying refractivity structure in the lower troposphere can cause significant multipath at the receiver during an occultation experiment. This presents serious challenges on two sides: first, the tracking of the signals by the GPS receiver and second, the inversion of the signal. On the receiver side, the high dynamics of the occultation signal in the presence of multipath makes it difficult to track in the usual "phase lock" loop normally applied in the GPS receiver. It is possible to overcome this limitation by use of various techniques such as "open loop" or "fly wheeling". On the side of the inversion, multiple signals arriving at the receiver at any given time create an ambiguity in determining the ray impact parameter based on the Doppler measurements. A promising method for resolving this problem is to backpropagate the amplitude and phase measured at the receiving satellite to a plane closer to the ray tangent point via the Kirchhoff diffraction integral.

An end-to-end system was created at JPL to test various tracking techniques and to assess the backpropation method. This system includes (1) the generation of synthetic GPS occultation data by the use of a multiple phase screen model, (2) the processing of the synthesized data through a copy of the BlackJack receiver (currently on board CHAMP and SAC-C), and (3) the inversion of that data by use of backpropagation.

Using this system, we examine various tracking techniques and assess the effectiveness of backpropagation when noise and receiver tracking errors are present in the data. Our presentation will consist of various simulation scenarios and of results obtained from CHAMP and SAC-C by the use of the backpropagation method.

Oral presentation on "Atmosphere/Ionosphere 4" or "Atmosphere/Ionosphere 6" is preferred.

Presenting and corresponding author:

Chi O. Ao
Jet Propulsion Laboratory M/S 238-600
California Institute of Technology
4800 Oak Grove Drive, Pasadena, CA 91109 USA

Email: chi.o.ao@jpl.nasa.gov
Phone: 818-393-6640; Fax: 818-393-4965